bombardment of the water molecules in which the particle is immersed shatters the particle beyond the ability of the molecules in the solid to hold together as a solid mass. The atoms of calcium, magnesium, potassium and sodium in the molecule of the silicate would go for the most part into true solution, while the atoms of silicon, aluminum, and iron would go chiefly into colloidal solution forming the basis of the colloidal matter or the ultra clay of the soil. It should be possible for the mathematical physical chemist, from physical constants now known, to determine empirically the relative size of the particle of matter which could withstand such bombardment without complete disintegration. This is a problem which has not yet been worked out.

This is one way of looking at their origin, but the results of our experimental work on soil colloids force us to adopt quite a different view. One that is not based on bombardment of water molecules, but one based largely on chemical reactions.

Many soil particles are hydrated silicates which contain varying amounts of aluminium, iron, silcon, sodium, potassium, calcium, magnesium and other elements in smaller quantities. Soil chemists claim that these particles are surrounded with a water-film, and that this film is held tenaciously. In the light of this the salts in the outer layer of these soil particles are subjected to constant hydrolysis. The hydrolytic products of the soluble compounds of sodium, potassium, etc., are partly taken up by this water film by way of solution, and part of them are adsorbed by the hydrolytic insoluble products of the iron and alumina salts which form a gel casing for the soil particle, that is, there is an equilibrium of the soluble salt between the water film and the insoluble gel which now surrounds the soil particle.

When the soil becomes flooded as after a rain, and the water moves down through the soil, the soluble salt of the water film is partly removed by diffusing into the moving water. This destroys the salt equilibrium between the water film and the incasing gel, and, hence, some of the soluble adsorbed salt is released to the water film. This continues until most of the soluble material is leached from the outer layer of the soil particle. This leaching may be continued until the incasing hydrolytic gel products of alumina and silica, and ferric oxide may pass into colloidal solution. Not only will the freedom of electrolytes tend to bring the incasing gel into colloidal solution but some of the soluble salts themselves or some salts that are moving through the soil under the proper hydrogen ion concentration will very much hasten their pepitization.

The pepitization of the hydrolytic insoluble compounds removes the encasing gel and the soil particle is again exposed to hydrolytic action, and in this way the weathering of the silicate particles proceeds. The pepitized gel or hydrosol moves through the soil, provided the pepitization is great enough, until it encounters a coagulating electrolyte or different hydrogen ion concentration, when it comes back as the gel and may be deposited on a soil particle, or come down as a precipitate where it remains as an adsorbent and reservoir for plant food until the conditions are sufficiently changed for it to pass back into the hydrosol; that is, the process is reversible

$$\text{hydrogel} \rightleftarrows \text{hydrosol}$$

and whether it is a hydrosol or a hydrogel depends on the soil environment.

Certain soil salts in our work have brought about a very beautiful pepitization, while other salts have brought about an equally definite coagulation. Then there are salts that lie in between these extremes. Again the same salts and same concentration have brought about both coagulation and pepitization by changing the hydrogen ion concentration.

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A CRAYFISH TRAP

IN ponds and streams where crayfish are abundant they can be readily taken by means of a trap constructed as follows: A rectangular box of any convenient size, sixteen by twenty-four inches for instance, is built of one-fourth inch mesh galvanized screen wire. Into one end of this box a removable funnel of like material is fitted. This funnel should project about eight inches into the box and have a flattened opening about four inches wide and an inch and a half deep. In setting the trap

it should be placed in shallow water on a sloping bank and partially embedded in the mud or sand so that the bottom of the funnel is even with the bottom of the pond. The rest of the trap extends out toward the deeper water. A dead fish wired securely to the bottom of the trap makes an excellent bait. Attracted by this bait, the crayfish crawl into the trap and seem to be unable to find their way back out. A single night-set with such a trap will reward the trapper with at least a water bucket full of crayfish for laboratory use, or for the more immediate purpose of supplying the camp with an exceedingly delectable breakfast.

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SPECIAL ARTICLES

NOTE ON THE RELATION BETWEEN THE PHOTIC STIMULUS AND THE RATE OF LOCOMOTION IN DROSOPHILA

IT is a fact demonstrated by many investigators that *Drosophila melanogaster* (ampelophila) is negatively geotropic and positively phototropic. In addition it is also known that light acts as a kinetic stimulus as well as a directive one. When the individual is illuminated, therefore, its movement is determined by the three factors operating simultaneously. If light acts in opposition to gravity the rate of upward crawling of the fly is lowered; and if light acts with gravity the rate is increased. Since the stimulus of gravity is always constant, and the photokinetic stimulus constant within wide limits, the rate of upward crawling is a measure of the effect of the phototropic stimulus.

Definite quantitative results have been obtained by measuring with a stop-watch the time necessary for wild flies to crawl to the top of a glass cylinder under three different intensities of light. Illuminated from above with a light of 1,500 candle meters the time taken for 50 per cent. of the experimental flies to reach the top (a distance of 172 mm) was found to be 6.17 seconds. With an intensity of 750 c.m., 7.6 seconds; and with an intensity of 75 c.m., 10.89 seconds. Each of these determinations is the average of 50 trials with 87 animals selected from five different cultures. The age of the flies varied between six and nine days. Under the illumination of a ruby lamp giving only enough light to enable observation, the time consumed in reaching the top was 11.3 seconds. There is then a definite relationship between the intensity of illumination and the rate of movement, which may be expressed by the Weber-Fechner law, as was done in the case of the Japanese beetle.[1] Figure 1 expresses this relationship.

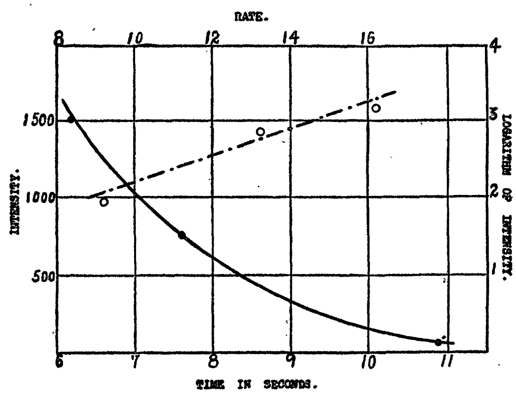

FIG. 1. Two graphs indicating the relation between light intensity and the phototropic orientation of *Drosophila*. The circles are points, at which $\text{Rate} = \dfrac{100}{\text{Reaction time in seconds}}$, plotted against the log of the intensity. The solid dots show the reaction time plotted against the intensity.

The broken line is obtained by plotting the logarithm of the intensity against the rate of locomotion, where rate equals 100 divided by the reaction time in seconds. From this graph it may be concluded that the sensation is proportional to the logarithm of the intensity of the stimulus. The continuous line is obtained by plotting the reaction time in seconds against the intensity of light and leads to the same conclusion.

It was found by McEwen[2] that the mutants

[1] Moore, A. R., and Cole, W. H.: "The response of *Popillia japonica* to light and the Weber-Fechner law," *Jour. Gen. Physiol.*, 3: 331, January, 1921.

[2] McEwen, R. S.: "The reactions to light and to gravity in *Drosophila* and its mutants," *Jour. Exp. Zool.*, 25: 49, February, 1918.